

DESCRIPTIONS OF TWO NEW SPECIES OF ENTOMOSTRACA  
FROM COLORADO, WITH NOTES ON OTHER SPECIES.

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The following notes and descriptions are based upon material collected by the author during four seasons spent at the Summer Mountain Laboratory of the University of Colorado, at Tolland, Colorado. The laboratory is at an elevation of about 8,900 feet, at the edge of an area with a large number of small glacial lakes, in which is found an abundant entomostrocan fauna.

Subclass PHYLLOPODA.

Order ANOSTRACA.

Family STREPTOCEPHALIDAE.

STREPTOCEPHALUS COLORADENSIS, new species.

*Male.*—The frontal appendage is finger-shaped and reaches to about three-fourths of the length of the first joint of the second antennae. The first antennae are slender, slightly tapering, and reach about to the end of the first joint of the second antennae. The second antennae are of the usual three-jointed type of the genus. The first joint is about twice as long as wide, very slightly curved backwards, and has the front margin decidedly longer than the back. It is slightly narrower at the distal than at the proximal end. The appendage at the posterior distal margin is about as long as the joint itself, is slender and moderately tapering. The second joint is much more slender than the first and just a little shorter. It is bent abruptly at about the middle. The third joint is shorter than either of the others and bears two long appendages which cross each other scissors fashion, the proximal one being on the outside. These appendages are directed in a downward and posterior direction. The proximal one has a length about equal to the combined length of the first two joints of the antenna. Its proximal two-fifths is flattened and its forward margin is rolled inward, forming a very

decided concavity. At the posterior distal margin of this portion is a short fingerlike process which is not hooked over the other appendage as in *S. sealii* Ryder. The rest of the appendage is a slender structure with an elbowlike bend at about its proximal third, beyond which it tapers uniformly and curves slightly forward. The distal appendage of the third joint is about two-thirds as long as the proximal. Just a little short of the middle it curves rather sharply forward through nearly 90°. The portion proximal to this bend bears on its anterior margin two fingerlike processes, the distal of which is about twice as long as the proximal. Beyond the bend, this appendage is slightly curved backward and tapers to a point. (Fig. 1.) The



FIG. 1.—STREPTOCEPHALUS COLORADENSIS.  
HEAD OF MALE.  $\times 8$ .

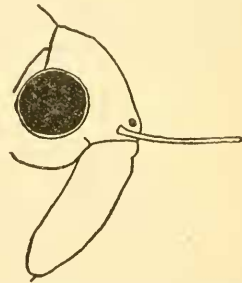


FIG. 2.—STREPTOCEPHALUS COLORADENSIS.  
HEAD OF FEMALE.  $\times 8$ .

coiled vas deferens appears externally on the side of the 13th segment. The two penes are nearly in contact at their extremities and reach not quite to the middle of the 15th segment.

Average length 22 mm.

*Female*.—The first antennae are as in the male. The second antennae are of the usual broad and flattened type and are about as long as the first. The end is rounded, but bears a small spinelike outgrowth at the inner distal margin. (Fig. 2.) The ovisac is about half the diameter of the abdomen, arises from the 14th postcephalic segment, and reaches about to the middle of the 18th. The eggs are of moderate size and are arranged in four definite rows.

Average length 23 mm.

In both sexes there are 11 pairs of swimming feet.

This species is common in two ponds near Eldora, Colorado, in the Front Range of the Rocky Mountains at an elevation of 8,500 feet. I collected material here during the summers of 1913 and 1914. A collection recently sent me from Fort Collins, Colorado, near the

western edge of the great plains, contains an abundance of this species.

*Type-locality*.—Sulphide Pool, near Eldora, Colorado.

*Type*.—Male, Cat. No. 47876, U.S.N.M.; paratype, female, Cat. No. 47876, U.S.N.M.

### Subclass COPEPODA.

## Order EUCOPEPODA.

### Family CENTROPAGIDAE.

#### DIAPTOMUS ARAPAHOENSIS, new species.

This is a red species of moderate size. The cephalothorax is moderately slender, with its greatest width about the middle (posterior margin of second segment). The last segment is produced posteriorly on either side into a somewhat triangular lobe of considerable size, less pronounced in the male than in the female. Each lobe bears two small spines, one at the distal angle, and the other at about the middle of the inner dorsal margin. The first segment of the female abdomen is slightly less in length than the two following. Its greatest width is somewhat beyond the middle, back of which it becomes abruptly narrower. It bears two spines on either side, a moderate-sized one at the point of greatest width, and a smaller one about halfway between this point and the posterior end of the segment. The second segment is indistinctly separated from the first, is slightly shorter than the third, and its length is slightly less than its width. The furcal rami are a little shorter than the third segment, are ciliated on the inner margin and have a few cilia on the outer margin also. (Fig. 3.) The female antennae reach slightly beyond the end of the cephalothorax. The male antennae are relatively longer, reaching beyond the middle of the abdomen. The male right antenna is moderately enlarged. Its antepenultimate segment bears a slender, straight process, which reaches about to the middle of the ultimate segment. (Fig. 4.) The first basal segment of the female fifth foot bears the customary small spine. The lateral hair of the second basal segment is slender. The first segment of the exopodite is a little more than twice as long as broad. The claw of the second segment is slightly sinuous, its inner margin is finely denticulate, and its outer margin bears some small spines. There is a small spine at the outer distal margin of this segment.

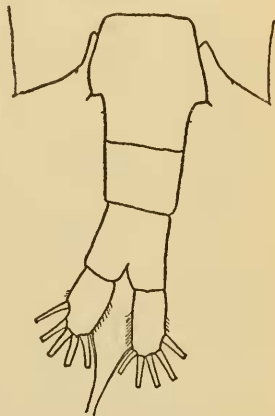


FIG. 3.—DIAPTOMUS ARAPAHOEN.  
SIS. ABDOMEN OF FEMALE—  
× 50.

The third segment is distinct and unusually well developed. It bears two spines, the inner of which is slightly setose and about twice as long as the outer one. The endopodite reaches about to the middle of the first segment of the exopodite and bears two or three small spines near its tip. (Fig. 5.) The spine of the first basal segment of the male fifth feet is of moderate size. The second basal segment of the right foot is about one-fourth longer than wide and bears, at about the middle of its inner surface, a small hyaline appendage. The lateral hair is slender and arises at about the beginning of the distal third of the segment. The first segment of the exopodite is short and its outer margin is much longer than the inner. At its outer distal angle it bears a hyaline appendage. The second segment is about twice as long as broad, having its greatest width a little beyond the middle. From this point arises the lateral spine, which is about as long as the segment, nearly straight, and uniformly tapering to a sharp point. It extends in a direction but little divergent from the axis of the segment. Its inner margin is very finely denticulate. This segment has a small crescent-shaped hyaline elevation about the middle of its posterior surface. The terminal hook is considerably longer than the rest of the exopodite and tapers to a very fine point. It is falciform, with slightly recurved tip, and is finely denticulate on its inner margin. The endopodite reaches to about the middle of the second segment of the exopodite, and is moderately pointed at the tip, near which are a few very small spines. The left fifth foot, exclusive of the long appendages, reaches a little beyond the end of the first segment of the right exopodite, and including the appendages, extends nearly to the end of its second segment. The second basal segment of this foot is about one-fourth longer than broad. There is a small hyaline appendage on its inner margin just a little short of the middle and the lateral hair arises at the end of the second third of the outer margin. The combined length of the two segments of the exopodite about equals the length of the second basal segment. The first segment of the exopodite is about half as wide at its distal as at the proximal end and its inner surface bears a setose pad. The second segment is somewhat shorter than the first and there is a prominent setose pad on its inner surface. The curved terminal processes almost equal the combined length of the two segments. The outer one is blunt



FIG. 4.—DIPTOMUS ARAPAHOENSIS. LAST THREE SEGMENTS OF RIGHT ANTENNA OF MALE.  $\times 188$ .

The combined length of the two segments of the exopodite about equals the length of the second basal segment. The first segment of the exopodite is about half as wide at its distal as at the proximal end and its inner surface bears a setose pad. The second segment is somewhat shorter than the first and there is a prominent setose pad on its inner surface. The curved terminal processes almost equal the combined length of the two segments. The outer one is blunt



FIG. 5.—DIPTOMUS ARAPAHOENSIS. FIFTH FOOT OF FEMALE.  $\times 82$ .

at the tip and bears on its convex (inner) surface a row of small teeth. The inner one is more slender, tapers uniformly to a fine point, and is finely setose. The endopodite nearly equals the exopodite in length and bears near the tip a few very small spines. (Fig. 6.)

Length of female, 2.1 mm. Length of male, 1.7 mm. These are the measurements in the lakes where they attain the greatest size. In one lake they were respectively 1.6 and 1.35 mm.

I have found this species in four mountain lakes in Colorado at elevations of about 11,000 feet.

Three of these lakes, known locally as the Arapahoe Lakes, are located just east of the Continental Divide a short distance from the railroad station Corona, on Rollins Pass. The fourth locality is a lake about 12 miles farther north. *Diaptomus shoshone*

Forbes is also found in each of these lakes.

*Type-locality*.—South Arapahoe Lake, Colorado.

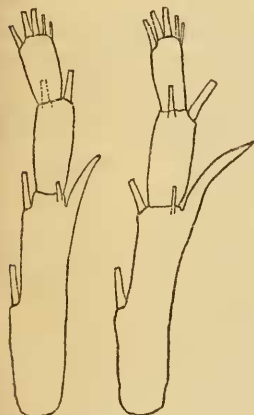
*Type*.—Male, Cat. No. 47878, U.S.N.M. Paratype, female, Cat. No. 47878, U.S.N.M.

#### DIAPTOMUS LINTONI Forbes.

This species was collected and described by Forbes<sup>1</sup> from Yellowstone Park where he found it "common in lakes and pools."

Apparently it has not since been collected until it appeared in

FIG. 7.—DIAPTOMUS LINTONI. LAST THREE SEGMENTS OF MALE RIGHT ANTENNA, SHOWING THE TWO EXTREMES OF THE APPENDAGE OF THE ANTEPENULTIMATE SEGMENT.  $\times 188$ .



my collections from Colorado. During the summers of 1908, '12, '13, and '14, I have found it as an important part of the fauna of two lakes, known as Teller Lakes, near the town of Tolland, Colorado, at an elevation of 9,575 feet. Though collections were at the same time made from a considerable number of other lakes in the same region, the species was found only in these two lakes. Forbes states that in Yellowstone Park it occurs commonly with *D. shoshone*. The two lakes in which I have found the species are just about at the lower altitudinal range of *D. shoshone* in this region. In one of them it forms a minor part of the fauna and in the other I have never found it.



FIG. 6.—DIAPTOMUS ARAPAHOENSIS. FIFTH FEET OF MALE.  $\times 82$ .



FIG. 8.—DIAPTOMUS LINTONI. TERMINAL SEGMENTS OF MALE RIGHT ANTENNA. COPIED FROM FIGURE OF FORBES.

<sup>1</sup>S. A. Forbes, A preliminary report on the aquatic invertebrate fauna of the Yellowstone National Park, Wyoming, and of the Flathead region of Montana. Bull. U. S. Fish Com., 1891, pp. 207-258.



These specimens agree well with the description of Forbes except in one particular which seems worthy of comment. He figures the antepenultimate segment of the male right antenna with a *straight* process, though in his description he does not state whether it is straight or curved. Marsh,<sup>1</sup> in his key, interprets it as a straight process. In my material this process is always decidedly curved, though it varies considerably in length. The conditions represented in figure 7 show the two extremes between which most specimens lie. Figure 8 is a copy of Forbes's drawing from the Yellowstone material.

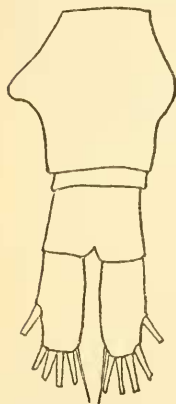


FIG. 9.—DIAPTOMUS SHOSHONE. FEMALE ABDOMEN.  $\times 50$ .

This is the most common Copepod in the mountains west of Denver, where I have collected it at elevations from 9,575 to 12,188 feet, but mostly in lakes above 11,000 feet. It ranges along the highest parts of the Rocky Mountain range, having been collected by Forbes in the Yellowstone region and by Ward<sup>2</sup> at Pikes Peak. Though Forbes does not figure the female abdomen, he describes it as being asymmetrical. Marsh<sup>2</sup> states that in the Pikes Peak material he does not find this to be the case as does also Schacht<sup>3</sup> who studied Forbes's collections. Marsh's figures, however, drawn, I suppose, from the Pikes Peak material, show the first segment of the female abdomen as distinctly asymmetrical. In my collections this asymmetrical condition prevails, as illustrated in figure 9. Marsh mentions the fact that he finds the endopodite of the female fifth foot and of the left male fifth foot to be indistinctly two-segmented. This is also the case with my specimens. It may also be worthy of note that in some lakes the appendage of the antepenultimate segment of the male right antenna is much longer than is the general rule, reaching well beyond the end of the ultimate segment.

DIAPTOMUS LEPTOPUS, var. PISCINAE Forbes.

This is the most common representative of the genus in the lakes of the Tolland region below 11,000 feet. In all my specimens the hyaline lamella of the antepenultimate segment of the male right antenna is expanded at the distal end into a very decided angle, as seen in figure 10. So far as I know, this has not been mentioned or figured for material from other localities.



FIG. 10.—DIAPTOMUS LEPTOPUS, VAR. PISCINAE. TERMINAL SEGMENTS OF MALE RIGHT ANTENNA.  $\times 188$ .

<sup>1</sup> C. Dwight Marsh, A revision of the genus *Diaptomus*. Trans. Wis. Acad., vol. 15, pt. 2, 1907, pp. 381-486.

<sup>2</sup> C. Dwight Marsh, Report on the Copepoda, In A biological reconnaissance of some elevated lakes in the Sierras and the Rockies, by Henry B. Ward. Studies from Zool. Lab. Univ. of Nebr., vol. 3, 1904, pp. 146-149.

<sup>3</sup> F. W. Schacht, The North American species of *Diaptomus*. Bull. Ill. State Lab. Nat. Hist., vol. 5, art. 3, 1897.